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Miller

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(54) **TIRE PRESSURE MONITOR INITIATION TOOL WITH VEHICLE DATA INTERFACE**

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B60C 23/00 (2006.01)

(52) **U.S. Cl.** ..... **340/426.33**; 73/146.2; 116/34 R

(58) **Field of Classification Search** ..... 340/426.33, 340/438, 442–449; 116/34 R, 34 A; 73/146, 73/146.2

See application file for complete search history.

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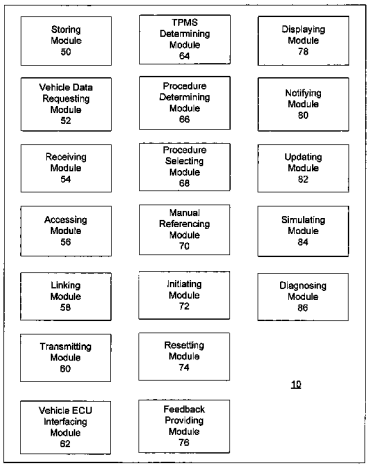
Primary Examiner—George A Bugg
(74) *Attorney, Agent, or Firm*—Baker & Hostetler LLP

(57) **ABSTRACT**

A tire pressure monitor system tool stores information regarding a plurality of tire pressure monitor systems installed on vehicles. The tool receives information regarding a particular vehicle. Based on this information, the tool may determine a particular tire pressure monitor system installed on a vehicle. Based on the tire pressure monitor system installed on the vehicle, the tool may determine one or more procedures that may be used with that tire pressure monitor system. The tool may then instruct a user how to perform certain procedures by presenting one or more displays to the user on a display of the tool. The tool may also provide feedback to the user regarding a status of an initiation or other procedure, and reference a vehicle user manual. The tool may interface with an electronic control unit of a vehicle. The tool may also simulate a tire pressure sensor.

59 Claims, 8 Drawing Sheets



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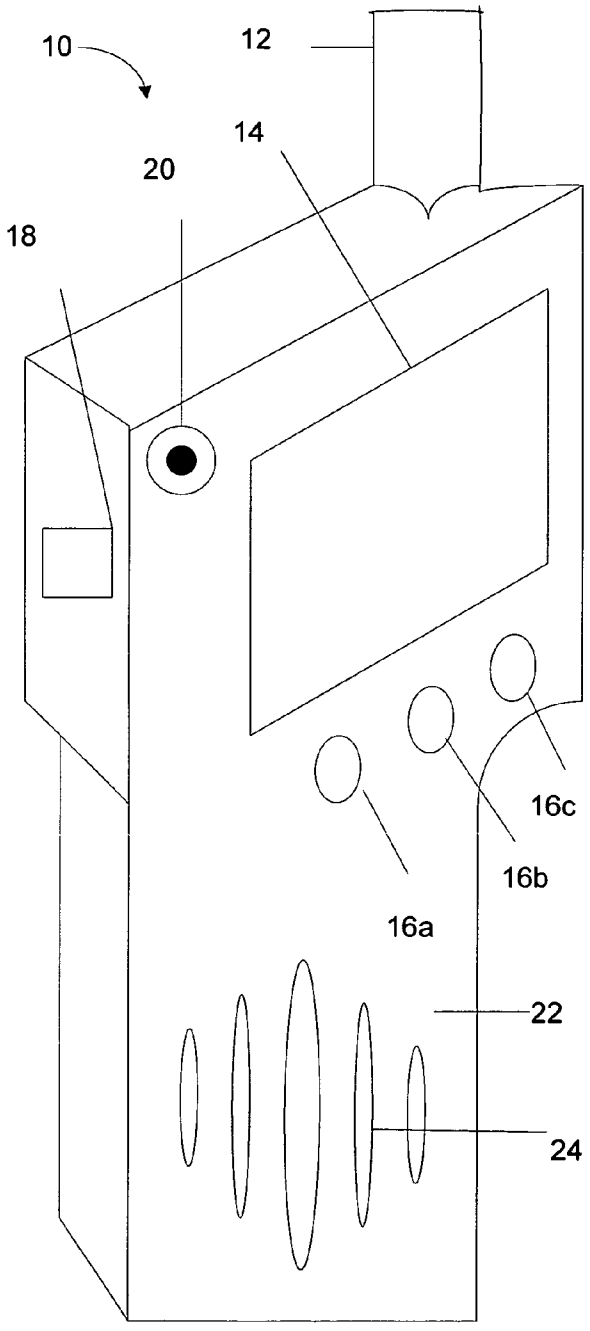


FIG. 1

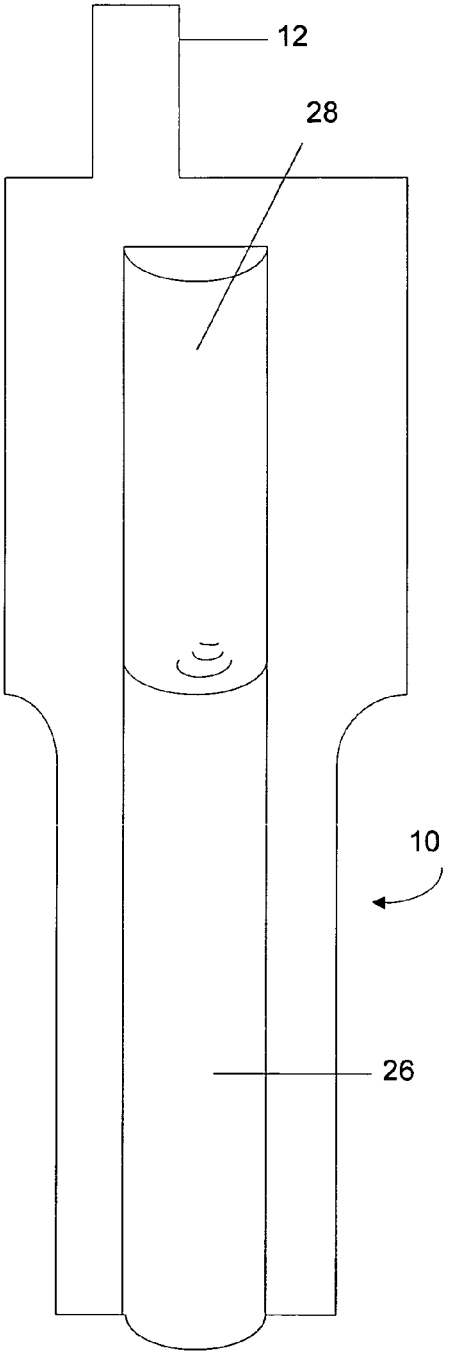


FIG. 2

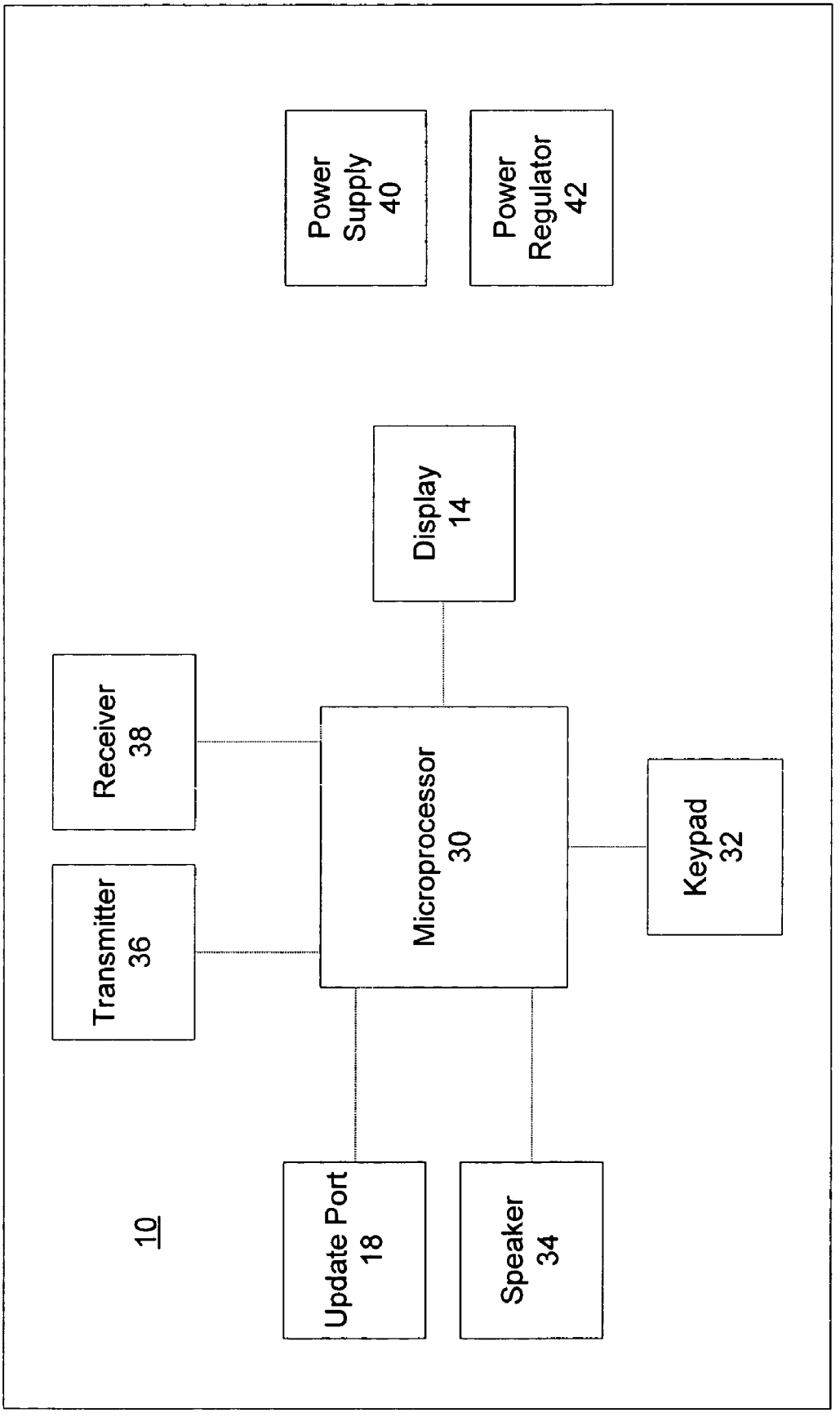

Power Supply 40
Power Regulator 42
Display 14
Receiver 38
Microprocessor 30
Keypad 32
Transmitter 36
Update Port 18
Speaker 34
10

FIG. 3

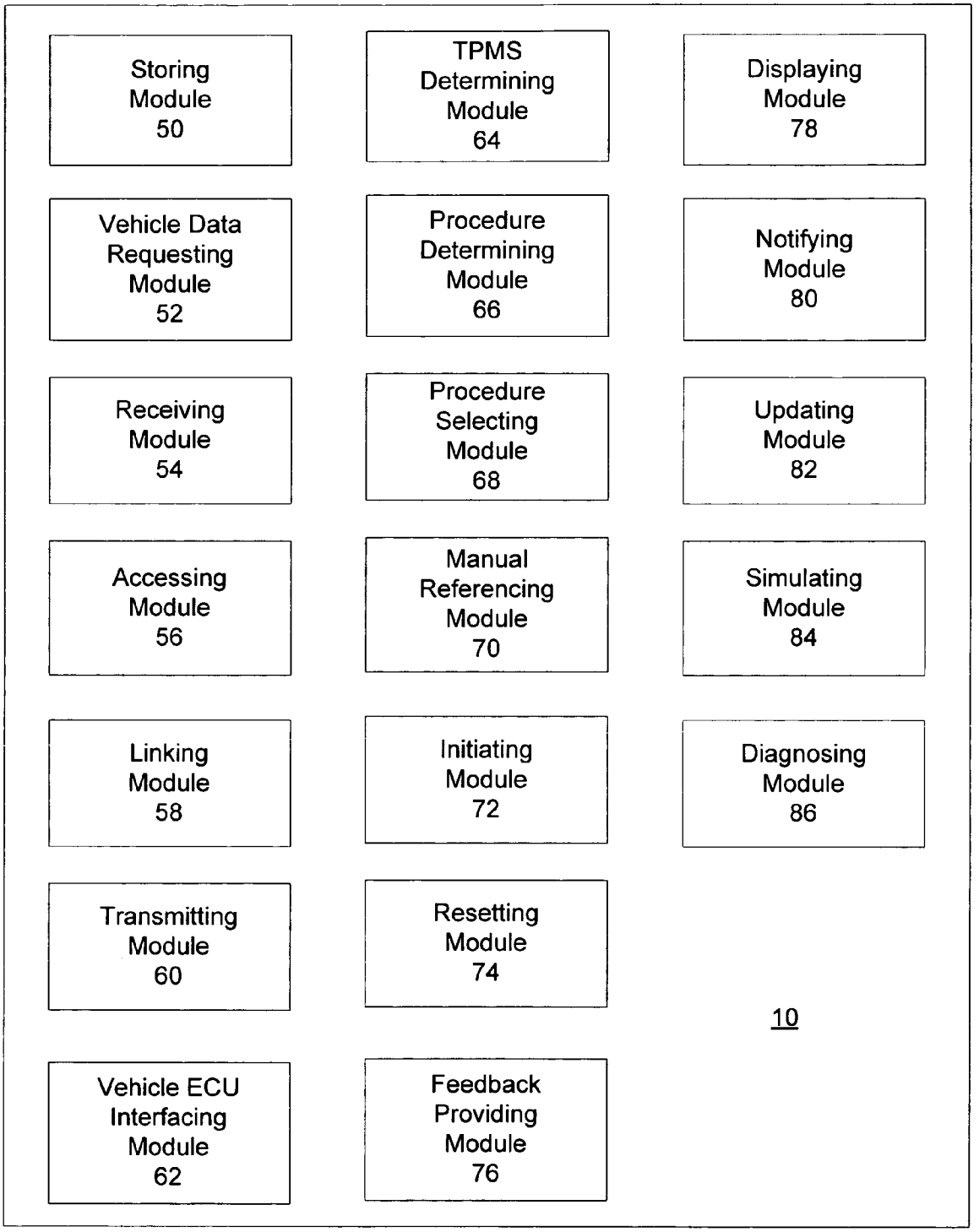

Storing Module 50
TPMS Determining Module 64
Displaying Module 78
Vehicle Data Requesting Module 52
Procedure Determining Module 66
Notifying Module 80
Receiving Module 54
Procedure Selecting Module 68
Updating Module 82
Accessing Module 56
Manual Referencing Module 70
Simulating Module 84
Linking Module 58
Initiating Module 72
Diagnosing Module 86
Transmitting Module 60
Resetting Module 74
10
Vehicle ECU Interfacing Module 62
Feedback Providing Module 76

FIG. 4

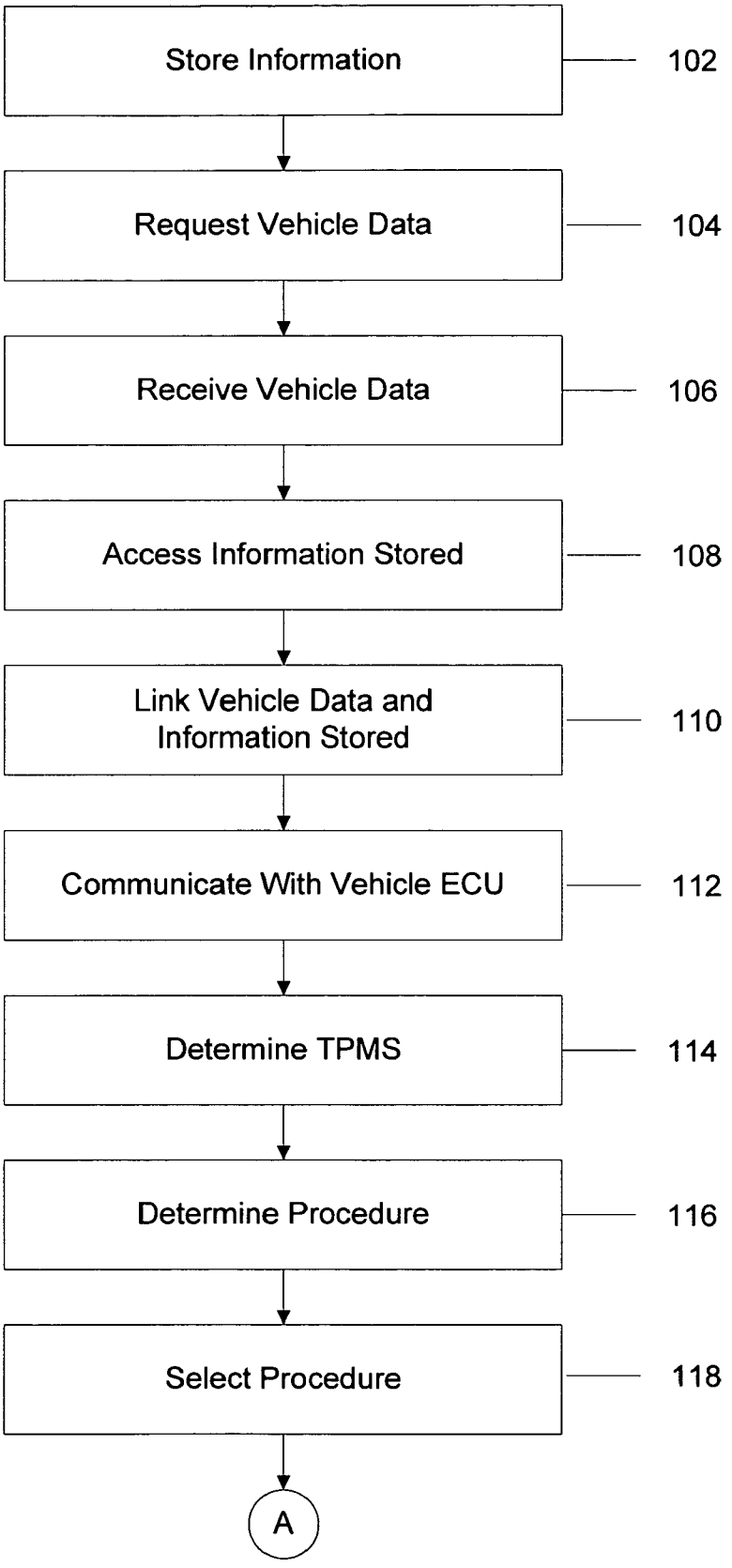

Store Information
102
Request Vehicle Data
104
Receive Vehicle Data
106
Access Information Stored
108
Link Vehicle Data and Information Stored
110
Communicate With Vehicle ECU
112
Determine TPMS
114
Determine Procedure
116
Select Procedure
118
A

FIG. 5

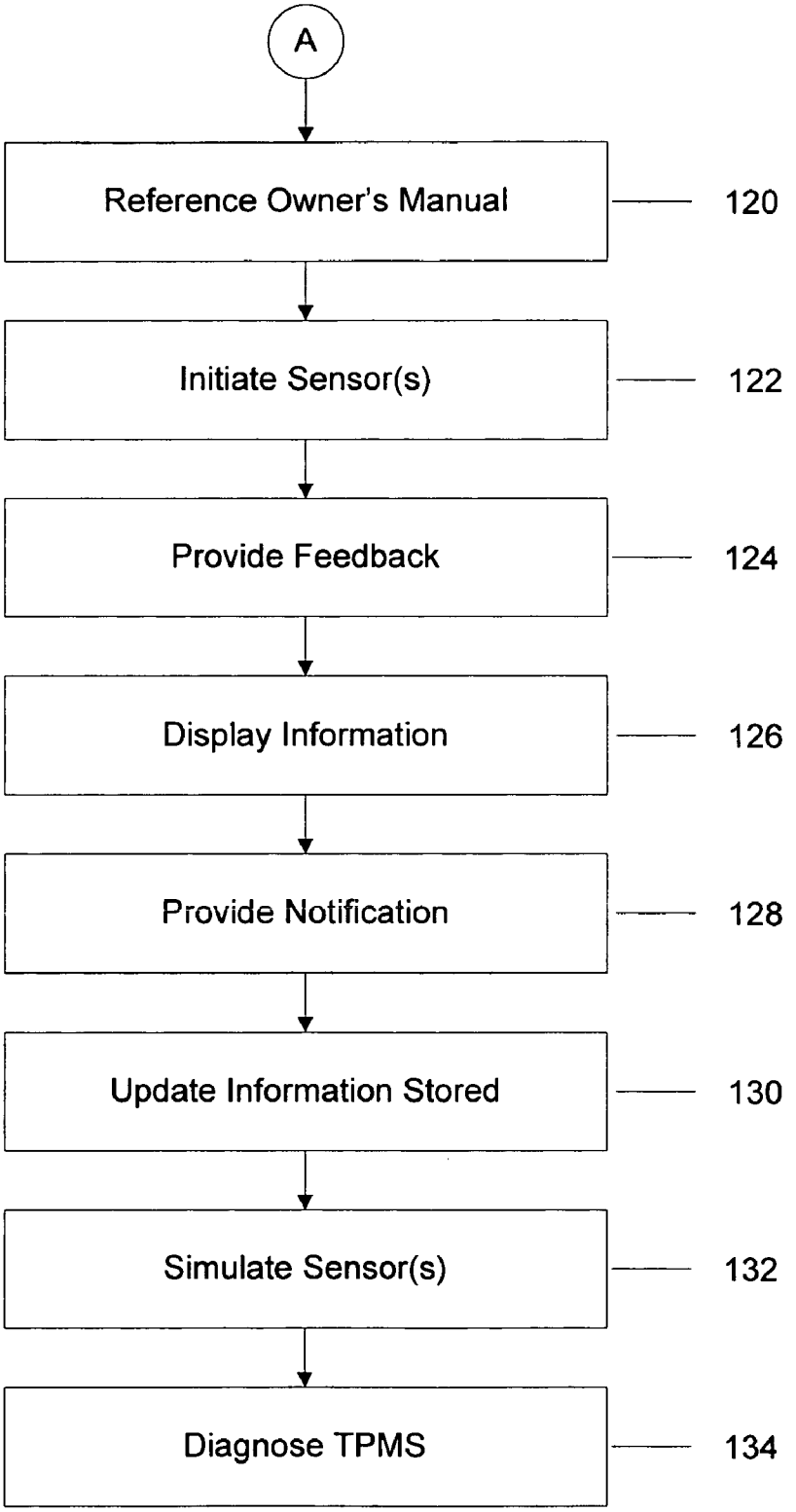

A
Reference Owner's Manual
120
Initiate Sensor(s)
122
Provide Feedback
124
Display Information
126
Provide Notification
128
Update Information Stored
130
Simulate Sensor(s)
132
Diagnose TPMS
134

FIG. 6

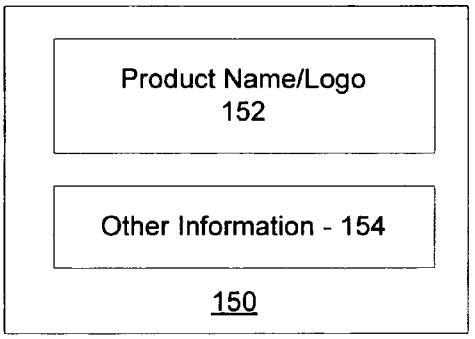


FIG. 7

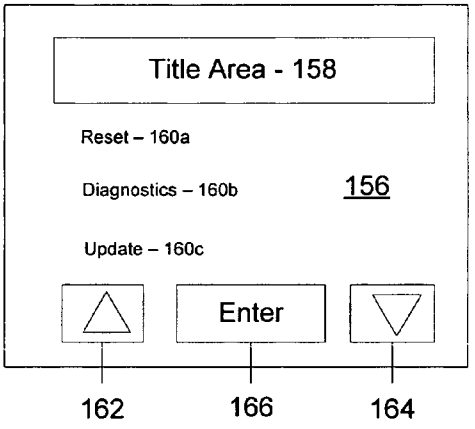


FIG. 8

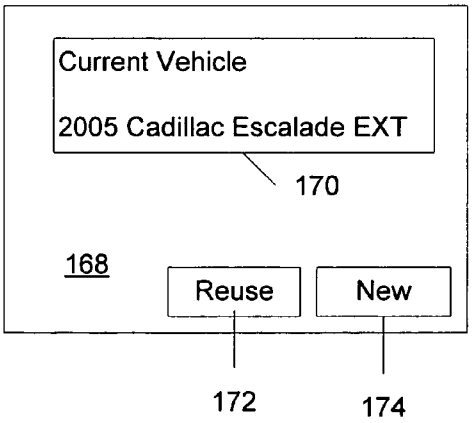


FIG. 9

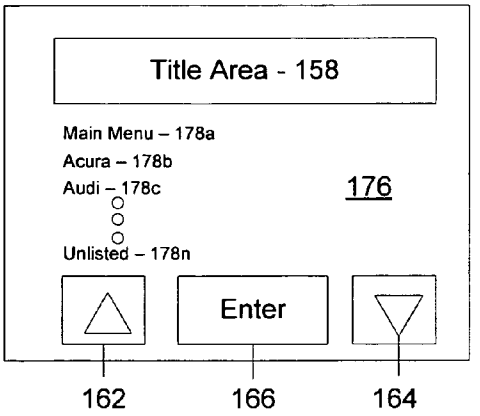


FIG. 10

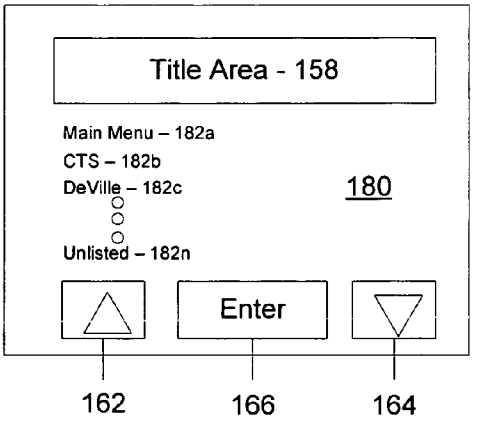


FIG. 11

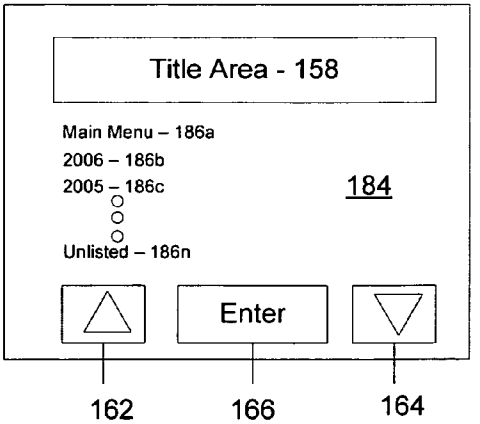


FIG. 12

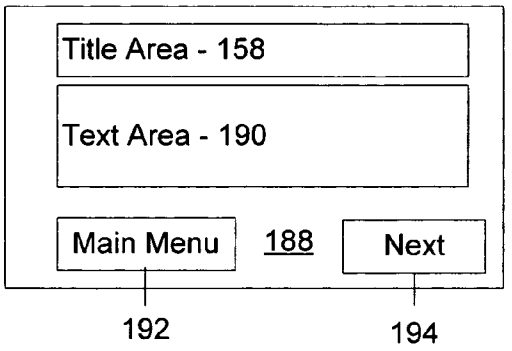


FIG. 13

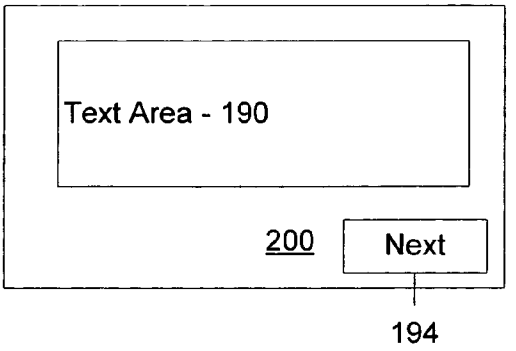


FIG. 15

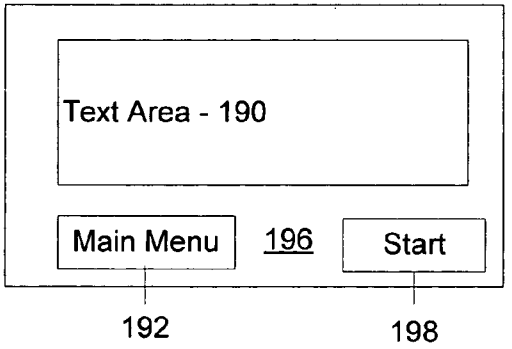


FIG. 14

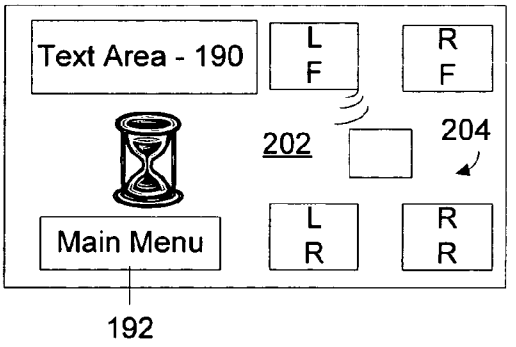


FIG. 16

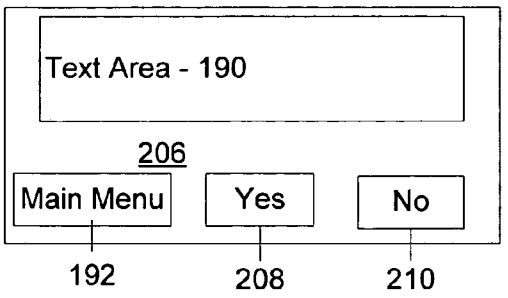


FIG. 17

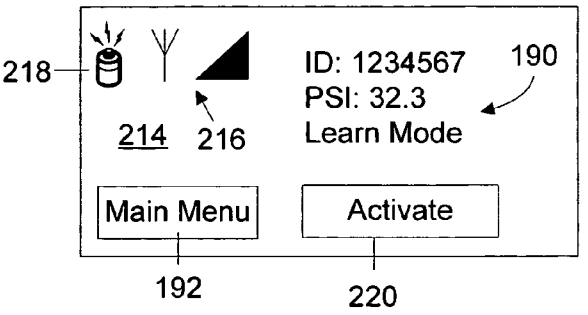


FIG. 19

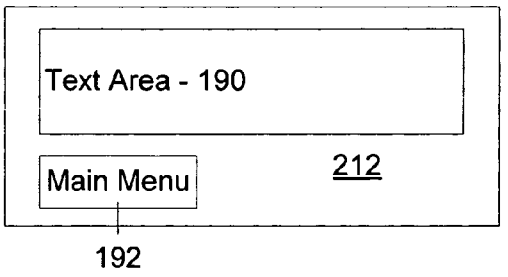


FIG. 18

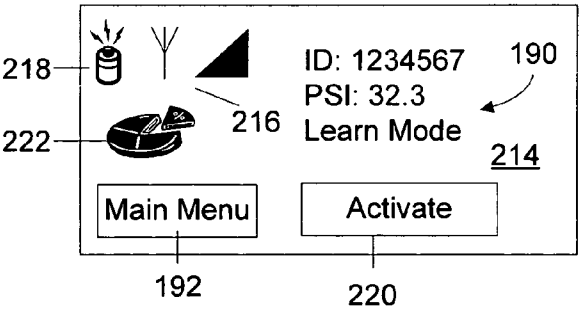


FIG. 20

TIRE PRESSURE MONITOR INITIATION TOOL WITH VEHICLE DATA INTERFACE

RELATED APPLICATIONS

This application is related to co-pending U.S. patent application titled "Tire Pressure Monitor System Tool With Vehicle Entry System," filed concurrently herewith, co-pending U.S. patent application titled "Tire Pressure Monitor System Module," filed concurrently herewith, and co-pending U.S. patent application titled "Tire Pressure Monitor System Tool With Re-Learn and Diagnostic Procedures," filed concurrently herewith, each of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The invention relates generally to tire pressure monitor systems. More particularly, the invention relates to a handheld tire pressure monitor system tool that interfaces with a vehicle electronic control unit.

BACKGROUND OF THE INVENTION

Systems have been developed to monitor, for example, vehicle tire pressure, and to report the tire pressure to a receiver at a central monitoring station using radio transmissions. A typical remote automotive tire condition monitoring system includes a plurality of tire-based sensory transponders and a central, vehicle-based arrangement. The sensory transponders include a component that senses a tire condition, such as tire inflation pressure or tire temperature. Each transponder is capable of outputting a coded transmission that conveys sensed tire condition information and an identifier for reception by the vehicle-based arrangement. Within the vehicle-based arrangement, an electronic control unit ("ECU") processes the conveyed information and controls provision of information regarding the sensed tire conditions to a vehicle operator. During operation of such a system, the vehicle operator is readily notified of a current tire condition, such as a low inflation pressure in a tire.

For a vehicle operator to determine which tire has a condition of interest (e.g., a low inflation pressure), information provided to the vehicle operator must unambiguously identify the location (e.g., right front) of the tire that has the condition of interest. In order for the ECU to provide such tire location information, the ECU has a memory that stores tire identification information for comparison with the identification conveyed from the transponder. Also, within the memory, a certain tire location is associated with each stored tire identification. Thus, once a provided identification is matched to a stored identification, a location on the vehicle is associated with the provided tire condition information. Accordingly, the operator is made aware that the tire at a certain location (e.g., right front) has the certain condition (e.g., low inflation pressure).

Changes routinely occur regarding the tires and/or transponders that are associated with a vehicle. The changes can result in new, different transponders being associated with the vehicle, or a rearrangement of the locations of the transponders, via rearrangement of the tires. Examples of such changes occur when one or more new tires with new transponders are mounted on a vehicle (e.g., the placement of the initial set of tires during vehicle manufacture or replacement of one or more tires), when the tires are rotated during routine maintenance, or when a transponder is replaced on an existing tire. It should be readily apparent that new/modified identification and location information regarding the tire must be provided or "taught" to the ECU.

In order to accomplish the "teaching" of the tire identification information to a vehicle-based portion, one known tire identification system is placed in a "learn" mode via actuation of pushbutton(s) on an operator-accessible information panel of the vehicle-based portion. During the learn mode, the vehicle-based portion is in a ready state to receive a distinctive "learn" mode signal transmitted from each of tire-based transmitter of the system. In order to cause each tire-based transmitter to send the "learn" mode signal, a strong magnet is swept over the outside of the associated vehicle tire.

A monitor is located at each tire and periodically takes a measurement of the tire pressure. A pressure signal is generated that corresponds to the pressure within the tire. The monitor transmits the measurement in a radio frequency transmission to the central monitoring station that produces an alarm or a display in response to the measurement. When the tire pressure drops below a predetermined pressure, an indicator is used to signal the vehicle operator of the low pressure.

During assembly and routine maintenance such as tire rotation or tire replacement, the tire pressure system must be calibrated. Calibration involves associating the various tire positions with the pressure transmitters that are located on the tires. One proposed method for calibrating a system uses a magnet device to initiate the calibration. In this system, an internal display panel with locations corresponding to the tire location is activated. When the tire locations are illuminated on the display, the vehicle operator or service technician places the magnet near the indicated tire. The transducer then sends a code corresponding thereto to the central controller. When the indicator indicates another tire location, the magnet must be brought near each tire location until each of the tire locations have a tire registered thereto. One problem with this device is that a separate component such as a magnet must be provided to the vehicle operator that is used only in the calibration process. One problem associated with a separate magnet device is that such a device is subject to loss. Thus, the tire pressure sensing system would be rendered inoperable.

One problem with such systems is the need to program the location of the transmitters at the central station. To be useful, the tire pressure is preferably associated with the tire which originated the measurement when presenting a display or alarm. Each monitor includes identification information that can be transmitted with the measurement. The tire monitor is preferably activated to produce this information and the information is conveyed to the central station and associated with the position of the tire.

In one technique, the tire monitors include a reed switch or other magnetic device. A magnet is passed near the reed switch causing the monitor to transmit a radio frequency transmission that includes identification data. A service technician repeats this process at each wheel and then loads the identification and position information into the central monitoring station.

One drawback with such a system is that because many wheels are made from steel which is a magnetic material, tire pressure sensing systems may not operate properly because the steel wheels may shield the magnetic energy. Therefore, the system may also be rendered inoperable because the pressure transmitter is not activated by the magnet.

Various tire manufacturers have suggested various locations for the pressure sensors. Known systems include coupling a pressure sensor to the valve stem of the tire. Other known systems and proposed systems locate the pressure sensors in various locations within the tire wall or tread.

These previous techniques have been limited in effectiveness. The magnetic programming technique may be subject to interference and crosstalk, for example in a factory where many such tire monitors are being assembled with tires and vehicles. Also, users of modular products are required to purchase a separate tool to interface with tire pressure monitor systems.

SUMMARY OF THE INVENTION

In accordance with one embodiment of the invention, a tire pressure monitor system tool is provided that combines various tire pressure sensor initiation functions with a vehicle data stream interface. The tool may store information regarding a plurality of tire pressure monitor systems that may be installed on one or more vehicles. The information may identify, for example, initiation procedures that may be used with a particular tire pressure monitor system and the tire pressure monitor systems installed on particular vehicles. The tool receives information regarding a particular vehicle. The information may be, for example, make, model, and year information. Based on this information, the tool may determine a particular tire pressure monitor system installed on a vehicle that has data matching the information. Based on the tire pressure monitor system installed on the vehicle, the tool may determine one or more initiation procedures that may be used with that tire pressure monitor system.

The tool may have the one or more initiation procedures stored by a storing module provided in the tool. The tool may then instruct a vehicle technician or other user how to initiate the tire pressure monitor system of the vehicle by presenting one or more displays to the user on a display of the tool. The displays may provide step-by-step instructions regarding how to initiate the tire pressure monitor system of the vehicle. The tool may also provide feedback to the user regarding a status of an initiation or other procedure, and reference a vehicle user manual.

In accordance with another embodiment of the invention, the tool may interface with an electronic control unit of a vehicle. This may be useful, for example, for diagnosing problems with a tire pressure monitor system. By interfacing with the electronic control unit, the tool may determine a tire pressure monitor system installed on the vehicle, use functions of the electronic control unit to analyze a tire pressure monitor system, and provide notice to a user regarding completion of a procedure. For example, by interfacing with the electronic control unit of the vehicle, the tool may cause a vehicle horn to sound or one or more lights to flash to indicate that a procedure has been successfully completed. Additionally, the tool may simulate a tire pressure sensor and communicate with the electronic control unit of the vehicle to determine whether a tire pressure sensor is fully operational.

There has thus been outlined, rather broadly, certain embodiments of the invention in order that the detailed description thereof herein may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional embodiments of the invention that will be described below and which will form the subject matter of the claims appended hereto.

In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of embodiments in addition to those described and of being practiced and carried out in various ways. For example, although the invention is described in terms of a plurality of modules, it is to be understood that the invention may be implemented using one or more modules. Also, it is to be understood that the phraseology and terminology employed herein, as well as the abstract, are for the purpose of description and should not be regarded as limiting.

As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front perspective view of a tire pressure mounting tool according to one embodiment of the invention.

FIG. **2** is a rear view of a tire pressure monitor tool according to one embodiment of the invention.

FIG. **3** is a block diagram of a tire pressure monitor tool according to one embodiment of the invention.

FIG. **4** is a block diagram of a tire pressure monitor tool according to one embodiment of the invention.

FIGS. **5** and **6** illustrate a method of communicating with a tire pressure monitor system of a vehicle according to one embodiment of the invention.

FIGS. **7-9** illustrate initial screens that may be displayed by a tire pressure monitor tool according to one embodiment of the invention.

FIGS. **10-18** illustrate procedure screens that may be displayed by a tire pressure monitor tool according to one embodiment of the invention.

FIGS. **19-20** illustrate diagnostic procedure screens that may be displayed by a tire pressure monitor tool according to one embodiment of the invention.

DETAILED DESCRIPTION

FIG. **1** illustrates a tire pressure monitor tool **10** according to one embodiment of the invention. The tool **10** includes an antenna **12**, display **14**, selector button **16***a*-**16***c*, port **18**, a power button **20**, a casing **22**, and passages **24**. The antenna **12** may be used to transmit signals from the tool **10** to an electronic control unit of a vehicle and a tire pressure sensor mounted, for example, on a rim or tire of a vehicle. The display **14** may be used to display information to a user regarding, for example, the tool **10**, a tire pressure monitor system of a vehicle or status information regarding a resetting or diagnostic function of the tool **10**. The selector buttons **16***a*-**16***c* may be used to navigate through the displays presented on the display **14** and select that certain functions be performed. The selector buttons **16***a*-**16***c* may be positioned below select displays presented on the display **14**. The selector buttons **16***a*-**16***c* may be used to select one of the selection displays presented on display **14**. The selection displays may be, for example, up and down arrows, an enter function, a menu function, start, activate, and next operations, yes, no, okay, redo, and stop functions, and reuse or new functions. The selection displays are described in further detail below.

The port **18** may be a port that enables the tool **10** to be connected to, for example, a computer or Internet connection that enables the tool to be updated with modified or additional information. The port **18** may be, for example, an RS232

serial port that connects the tool **10** to the computer or Internet connection using an RS232 serial cable. This is described in further detail below.

The power button **20** may be used to turn the tool **10** on and off. According to one embodiment of the invention, the tool may turn off automatically after, for example, three to four minutes of inactivity.

The casing **22** provides a housing for the tool **10**. The casing may be provided with the passages **24** that may be located in front of a speaker (not shown) that emits audible tones or other notifications while the tool **10** is being used.

FIG. **2** illustrates a rear view of the tool **10** according one embodiment of the invention. The tool **10** may be battery powered. Therefore, the tool **10** may be provided with a battery compartment **26**. The battery compartment **26** may include a removable battery cover **28** that allows removable insertion of batteries within the battery compartment **26**. According to one embodiment of the invention, the tool **10** is powered by three (3) size C batteries.

FIG. **3** illustrates a block diagram of the tool **10** illustrated in FIGS. **1** and **2**. The tool **10** may include a microprocessor **30** that processes software used to operate the tool **10**. According to one embodiment of the invention, the microprocessor is an ATMEGA2561 microprocessor having a clock speed of 8 Mhz. The microprocessor **30** communicates with a keypad **32**. According to one embodiment of the invention, the keypad **32** includes the selector buttons **16***a*-**16***c* illustrated in FIG. **1**. The microprocessor **30** may also be in communication with a speaker **34**. The speaker **34** may be used to provide audible tones or notifications during use of the tool **10**.

The microprocessor **30** may also be in communication with a transmitter **36** and a receiver **38**. The transmitter **36** may be used to transmit signals to a tire pressure sensor mounted on a wheel of a vehicle or an electronic control unit of a vehicle. According to one embodiment of the invention, the transmitter **36** operates at 125 khz. Although only one transmitter is shown, it is to be understood that multiple transmitters including transmitters of different types may be used.

The receiver **38** maybe used to receive signals transmitted from a tire pressure sensor mounted on a wheel vehicle and an electronic control unit of a vehicle. According to one embodiment of the invention the receiver **38** may operate at 315 Mhz and have a clock speed of 10.178 Mhz. Alternatively, the receiver **38** may operate at 433 Mhz and have a clock speed of 13.225 Mhz. Although only one receiver is shown, it is to be understood that multiple receivers operating at different frequencies and having different clock speeds may be used.

The tool **10** may also include a power supply **40**. As stated above, the power supply may be, for example, three (3) size C batteries. The power supply **40** may be in communication with a power regulator **42**. The power regulator **42** may be used to regulate the power supplied to each device of the tool **10**.

FIG. **4** illustrates a block diagram of the tire pressure monitor tool **10** shown in FIGS. **1** and **2** according to one embodiment of the invention. The tool **10** may include a storing module **50** that stores information regarding a plurality of tire pressure monitor systems. According to one embodiment of the invention, the information stored relates to a plurality of tire pressure monitor systems from a variety of vehicle manufactures and various models and years of the vehicles. The storing module **50** may be, for example, any suitable storage medium such as a storage module on a microprocessor, a hard disk, a removable storage media such as a flash disk for other suitable storage mechanism. The tool **10** also includes a vehicle data requesting module **52**. The vehicle data requesting module **52** may be used to request data regarding a particular vehicle for which the tool **10** may be used. The vehicle data requesting module **52** may present a user of the tool **10** with a plurality of screens displaying information regarding various vehicle types. For example, the user may be presented with the vehicle data associated with the vehicle for which the tool **10** was most recently used. According to another embodiment, the user may be presented with a series of screens displaying lists of various makes, models, and years of various vehicles. The user may use the selector buttons to navigate the lists and select the make, model, and year of a desired vehicle. A receiving module **54** may be used to receive input provided by the user.

An accessing module **56** may be used to access the information stored in the storing module **50** to determine whether any of the information stored by the storing module **50** is associated with the vehicle data input by the user. If the storing module **50** does not include any information associated with the vehicle data, the user may be notified that no information was located. If information associated with the vehicle data is located, however, a linking module **58** may be used to link the information with the vehicle data. The information may include, for example, communication protocols for communicating with an electronic control unit of the vehicle, procedures for resetting a tire pressure monitor system of the vehicle, diagnosing the tire pressure monitor system of the vehicle or other functions.

A transmitting module **60** may then be used to transmit a signal from the tool **10** to a tire pressure sensor of the vehicle or an electronic control unit of the vehicle. If the signal is transmitted to the electronic control unit of the vehicle, a vehicle electronic control unit interfacing module **62** may be used to interface with the vehicle electronic control unit. The tool **10** may interface with the vehicle electronic control unit to, for example, reset a tire pressure monitor system of the vehicle. As discussed above, tire replacement and rotation requires resetting of the vehicle's tire pressure monitor system. This enables the vehicle electronic control unit to maintain locations of each tire pressure sensor such that accurate information may be displayed to a driver of the vehicle using, for example, a dashboard display of the vehicle.

A tire pressure monitor system determining module **64** may be used to determine a type of tire pressure monitor system provided on the vehicle. This information may be obtained, for example, from the vehicle electronic control unit or by matching the vehicle data with vehicle data provided in a lookup table stored by the tool. The vehicle data may be associated with the particular type of tire pressure monitor system installed on the vehicle. Upon determining the tire pressure monitor system installed on the vehicle, a procedure determining module **66** may determine a procedure to be followed to, for example, reset or diagnose the tire pressure monitor system of the vehicle. Based on instructions input by a user, a procedure selecting module **68** selects the procedure corresponding to the instructions input by the user. Some procedures may require a user to perform procedures specific to a vehicle. These procedures are typically located in an owner's manual of the vehicle. Therefore, a manual referencing module **70** may be used to refer to the owner's manual so that the user may perform this procedure prior to continuing to use the tool **10**.

According to one embodiment of the invention, an initiating module **72** may be used to initiate one or more tire pressure sensors of a vehicle. Initiating the tire pressure sensors places the sensors in a state that enables the sensors to communicate with the tool **10** and the electronic control unit of the vehicle. After initiating the sensors, the tire pressure monitor

system of the vehicle may be, for example, reset using resetting module **74**. The resetting module **74** enables the electronic control unit of the vehicle to determine locations, identification numbers, and other information regarding the tire pressure sensors mounted one or more wheels of the vehicle. According to one embodiment of the invention, the antenna **12** of the tool **10** is placed adjacent a valve stem of a wheel of a vehicle. The tool **10** receives, for example, location, identification number, pressure information, and possibly other information from the tire pressure sensor using receiving module **54** and transmits the information to the vehicle electronic control unit using transmitting module **60**.

A feedback providing module **76** may be used to determine whether the tire pressure monitor system has been reset. For example, the feedback providing module **76** may cause symbols, text or other information to be displayed on the display **14** indicating that a reset procedure has been completed. The information may be displayed on the display **14** using displaying module **78**. A notifying module **80** may be used to notify the user that a reset or other procedure has been completed. For example, the notifying module **80** may cause an electronic control unit of a vehicle to sound a horn of the vehicle or flash one or more lights of a vehicle indicating that the reset or other procedure has been completed.

An updating module **82** may be used to update the information stored by the storing module **50**. The updating module **82** may be in communication with the port **18**. The updating module **82** may receive information from a computer, the Internet or other data source using, for example, an RS232 serial cable connected to the port **18** and the computer or other device. The updating module **82** may modify information stored by the storing module **50** or add information to the storing module **50**. Additional information may be, for example, information relating to tire pressure monitor systems installed on newer vehicles.

The tool **10** may also include a simulating module **84**. The simulating module **84** may be used to simulate a tire pressure sensor to validate the functionality of a tire pressure monitor system on a vehicle.

A diagnosing module **86** may also be used to diagnose a tire pressure monitor system on a vehicle. The diagnosing module **86** may be used to obtain, for example, tire pressure and other information from the sensor.

FIGS. **5-6** illustrate a method of communicating with a tire pressure monitor system of a vehicle using a tire pressure monitor tool according to one embodiment of the invention. In step **102**, information regarding tire pressure monitor systems and vehicles using such vehicles may be stored by the tire pressure monitor tool. The tool may be used to obtain tire pressure information from one or more wheels of a vehicle provided with tire pressure sensors. To communicate properly with a tire pressure sensor, the tire pressure tool must be provided with data regarding the vehicle from which tire pressure information is sought. Vehicle data may be requested using the tool as illustrated in step **104**. Vehicle data may be requested by, for example, displaying a make, model, and year of a vehicle and requesting that the user confirm or change the vehicle data.

If the vehicle data displayed is not related to the vehicle from which tire pressure information is sought, the tool may provide a series of displays to the user enabling the user to select a make, model, and year data from among a list of makes, models, and years. This information may be received by the tool in step **106**. The information stored in step **102** is then accessed in step **108** to determine whether tire pressure monitor system information relating to the vehicle data received by the tool is being stored. If information relating to the vehicle data is located, this information is linked with the vehicle data in step **110**.

The tool may use this information to communicate with the electronic control unit of the vehicle, step **112**. Based on the communication with the electronic control unit, a determination may be made regarding a tire pressure monitor system installed on the vehicle **114**. Based on the tire pressure monitor system installed, a determination may be made regarding a procedure to, for example, reset or diagnose the tire pressure monitor system, step **116**. The resetting or diagnosing procedure is then selected based on input provided by a user using the tool **10** as illustrated in step **118**. The resetting or diagnosing procedure may require a user to perform a procedure particular to the vehicle. Therefore, the tool may reference a vehicle owner's manual so that the user may follow the procedure identified in the owner's manual, step **120**. The procedure may be, for example, placing the vehicle in a learn mode such that the vehicle or electronic control unit is able to receive tire pressure monitor system information from tire pressure sensors provided on one or more wheels of the vehicle.

In step **122**, one or more of the tire pressure sensors provided on the wheels of the vehicle may be initiated. Initiating the tire pressure sensors enable the sensors to communicate with the tool **10** and the vehicle electronic control unit. Initiating the sensors may be performed by, for example, placing an antenna of a tire pressure monitor tool adjacent or near a valve stem of a wheel of the vehicle. The tool **10** transmits and receives information between the vehicle electronic control unit and the tire pressure sensor such that the vehicle or the electronic control unit may determine a location, identification number, tire pressure, or other information from the tire pressure sensor.

Feedback may be provided to the user to, for example, indicate that a sensor has been successfully initiated or that the signal has been received by the tire pressure monitor tool, step **124**. This information may be displayed on a display of the tire pressure monitor tool as illustrated in step **126**. The user may also be notified whether a resetting or diagnosing procedure has been completed, step **128**. For example, the tool **10** may cause the electronic control unit of the vehicle to sound a horn of the vehicle or flash one or more lights of the vehicle indicating that the resetting or diagnosing procedure has been completed.

According to one embodiment of the invention, the tool **10** maybe updated with modified or additional tire pressure monitor system information, step **130**. For example, the tool may be provided with a port that receives, for example, an RS232 serial cable that may be connected to a computer, the Internet or other data source such that tire pressure monitor system information may be communicated to the tool in step **130** and stored in step **102**. The tire pressure monitor system information may include modifications or additions to the information already stored by the tire pressure monitor tool.

The tool **10** may also simulate a tire pressure sensor of a vehicle, step **132**. The tool **10** may simulate the tire pressure sensor to validate the functionality of a tire pressure monitor system installed on a vehicle. The tool **10** may also be used to diagnose the tire pressure monitor system, step **134**. The tool **10** may be used to obtain information such as tire pressure and sensor identification information. Additionally, the tool **10** may obtain information regarding a battery condition of the batteries provided in the tire pressure monitor tool **10**.

FIGS. **7-9** illustrate initial displays that may be presented to a user of a tire pressure monitor tool according to one embodiment of the invention. FIG. **7** illustrates a display **150** that may

be, for example, a start up screen displayed on the tire pressure monitor tool display. The display **150** may include a product name and/or logo **152** and/or other information **154**. FIG. **8** illustrates a display **156** that may be, for example, a main menu of the tool. The display **156** may include a title area **158** for displaying a title of the display. The display **156** may include a plurality of a selectable options **160***a*-**160***c* that may be displayed in a list in the display **156**. The selectable options **160***a*-**160***c* may include, for example, reset **160***a*, diagnostics **160***b*, and update **160***c*. The selectable options **160***a*-**160***c* may be navigated using selection displays presented above selector buttons provided on the fire pressure monitor tool. The selection displays may be, for example, an up arrow **162** and a down arrow **164**. By pressing the selector buttons provided on the tool, a user may navigate up and down the display **156** to select a desired function. The function may be selected by pressing the selector button located beneath selection display Enter **166** provided on the display **156**. The tool may indicate a function to be selected by, for example, highlighting, circling, underlining or other formatting to distinguish the function to be selected among other selectable functions.

FIG. **9** illustrates a vehicle information screen display **168** that displays information regarding a particular vehicle. The display **168** may include an information display area **170** that displays vehicle data regarding a particular vehicle. The display **168** also includes selection displays **172**, **174** that enable a user to either reuse the vehicle data provided on the display **168** or create new vehicle data, respectfully. FIG. **10** illustrates a display **176** that enables a user to select a vehicle make. The display **176** may include a title area **158** that provides a title of the display. The display **176** may also include a list of selectable options **178***a*-**178***n* that a user may use to either select a vehicle make or return to the main menu. The display **176** may also include the selection displays **162**, **164**, and **166** described above. The user may use the selection displays **162**, **164**, and **166** to navigate and select a particular vehicle make or a main menu option for returning to the main menu.

If a user selects a vehicle make, the user may then be presented with a display **180** as shown in FIG. **11**. The display **180** may enable a user to select a particular model associated with the vehicle make selected using the display **176**. The display **180** may include a list of selectable models associated with the vehicle make selected and also enable the user to return to the main menu. The display **180** may also include the selection displays **162**, **164**, and **166** as described. The user may navigate the list provided in the display **180** and select a desired model. If a user selects a desired model, the user may be presented with a display **184** as illustrated in FIG. **12**. The display **184** may include a title area **158** and selection displays **162**, **164**, and **166** as described above. The display **184** may also include a list of years from which a user can select a desired year associated with the vehicle make and model previously selected. The display **184** may include a list having a main menu option **186***a* and a plurality of selectable years **186***b*-**186***n* from which the user may select.

If the user selects a vehicle year, the user may be presented with a display **188** as illustrated in FIG. **13**. The display **188** may include a title area **158** that provides a title of the display. The display **188** may also include a user instruction **190** providing a user with an instruction to perform a task. For example, the user may be instructed to refer to a particular section of the vehicle's user manual for performing a certain function. The display **188** may also include main menu selection display **192** and next selection display **194** displayed above two of the selector buttons provided on the tire pressure monitor tool. The user may use the selection displays **192**, **194** to return to a main menu of the tire pressure monitor tool or proceed to a next step of, for example, a reset procedure after performing the task instructed in the display **188**.

If the user selects the next selection display **194**, the user may be presented with a display **196** as illustrated in FIG. **14**. The display **196** includes an instruction **190** and a main menu selection display **192** as discussed above. The display **196** may also include a start selection display **198** presented above a selector button provided on the tire pressure monitor tool. If the user selects the start selection display **198**, the user may be presented with a display **200** as illustrated in FIG. **15**. The display **200** may include a user instruction **190** and a next selection display **194** as discussed above. After selecting the next selection display **194** the user may be presented with a display **202** as illustrated in FIG. **16**.

The display **202** may provide text and/or graphics **204** illustrating that the tool is performing a function and may provide details regarding that function. For example, during a reset procedure, the display **202** may indicate that a left front tire pressure sensor is being reset and instructs the user to please wait. The display **202** may also include a main menu selection display **192** as discussed above.

Upon completion of the function, a display **206** as illustrated in FIG. **17** may be presented on the tire pressure monitor tool. The display **206** may include a text area **190** that provides information to the user and may also include an interrogatory. The interrogatory may be, for example, "Did born sound?". The display **206** may include selection displays Yes **208** and No **210** that enable the user to answer the interrogatory. The selection displays **208**, **210** may be selected using selector buttons provided on the tool and below the selection displays. The selection **206** may also include a main menu selection display **192** as discussed above.

If the user selects Yes selection display **208**, the user may be presented with a display **212** as illustrated in FIG. **18**. The display **212** may include a text area **188** indicating that the procedure has been completed. The display **212** may also include a main menu selection display **192** as discussed above. If the user selects No selection display **210**, however, the tool may present a previous display such as, for example, display **196** as illustrated in FIG. **14**. This enables the user to repeat the procedure to attempt to properly complete the procedure.

FIG. **19** illustrates a diagnostic test screen display **214** according to one embodiment of the invention. The display **214** includes a text area **190** and main menu selection display **192** as described above. The text display **190** may include, for example, an identification number of a tire pressure sensor from which tire pressure information has been received, the tire pressure for that particular tire, and an operating mode of the electronic control unit of the vehicle. The display may also include a signal indicator **216** indicating whether a signal is being received from the tire sensor and a battery level indicator **218** indicating an approximate battery level remaining in the batteries of the tire pressure monitor tool. The display **216** may also include an activate selection display **220** that activates a diagnostic procedure of the tire pressure monitor tool. Upon selection of the activate selection display **220**, a signal transmitting signal symbol **222** may be presented in a display **218** to indicate that the tire pressure monitor tool is transmitting a signal to the tire pressure sensor as illustrated in FIG. **20**.

The many features and advantages of the invention are apparent from the detailed specification, and thus, it is intended by the appended claims to cover all such features and advantages of the invention which fall within the true

spirit and scope of the invention. Further, since numerous modifications and variations will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed is:

1. A tool for use with a tire pressure monitor system comprising:

a vehicle control unit interfacing module;

a tire pressure monitor system determining module, in communication with the vehicle control unit interfacing module, configured to determine a type of tire pressure monitor system installed on a vehicle; and

a tire pressure sensor initiating module, in communication with the tire pressure monitor system determining module, configured to initiate at least one tire pressure sensor.

2. The tool of claim **1**, further comprising a procedure determining module, in communication with the tire pressure monitor system determining module, configured to determine an initiation procedure associated with the tire pressure monitor system.

3. The tool of claim **1**, further comprising a procedure selecting module, in communication with the tire pressure monitor system determining module, configured to select an initiation procedure associated with the tire pressure monitor system.

4. The tool of claim **1**, further comprising a storing module configured to store information regarding at least one of a maintenance history and at least one tire pressure monitor system.

5. The tool of claim **4**, further comprising an accessing module, in communication with the storing module, configured to access the information stored.

6. The tool of claim **4**, further comprising an updating module, in communication with the storing module, configured to update the information stored by the storing module.

7. The tool of claim **1**, further comprising a displaying module configured to display at least one of vehicle information and tire pressure monitor system information.

8. The tool of claim **7**, wherein the tire pressure monitor system information comprises at least one of fire pressure, tire pressure sensor identification, and sensor mode.

9. The tool of claim **1**, further comprising a resetting module configured to reset the fire pressure monitor system.

10. The tool of claim **9**, further comprising a notifying module, in communication with the resetting module, configured to notify a user that a tire pressure monitor system has been reset.

11. The tool of claim **10**, wherein the notifying module is configured to notify the user by causing at least one of a vehicle horn to sound and at least one vehicle light to flash.

12. The tool of claim **9**, further comprising a manual referencing module configured to reference a vehicle user manual.

13. The tool of claim **12**, further comprising an update interface.

14. The tool of claim **13**, wherein the update interface comprises an RS232 port.

15. The tool of claim **1**, further comprising a diagnosing module configured to diagnose the at least one tire pressure sensor.

16. The tool of claim **1**, wherein the fire pressure monitor determining module requests vehicle data.

17. The tool of claim **16**, wherein the vehicle data comprises vehicle make, model, and year data.

18. The tool of claim **1**, wherein the tire pressure sensor initiating module comprises a feedback module configured to provide feedback regarding at least one of a signal received by the tool and successful initiation.

19. The tool of claim **1**, further comprising a transmitting module configured to transmit a signal from the tool to the tire pressure monitor system.

20. The tool of claim **1**, further comprising a receiving module configured to receive a signal from at least one of the tire pressure monitor system and the at least one tire pressure sensor.

21. A tool for use with a tire pressure monitor system comprising:

interfacing means for interfacing with a vehicle electronic control unit;

tire pressure monitor system determining means for determining a type of tire pressure monitor system installed on a vehicle; and

tire pressure sensor initiating means for initiating at least one tire pressure sensor.

22. The tool of claim **21**, further comprising initiation procedure determining means for determining an initiation procedure associated with the tire pressure monitor system.

23. The tool of claim **21**, further comprising initiation procedure selecting means for selecting an initiation procedure associated with the tire pressure monitor system.

24. The tool of claim **21**, further comprising storing means for storing information regarding at least one of a maintenance history and at least one tire pressure monitor system.

25. The tool of claim **24**, further comprising accessing means for accessing the information stored.

26. The tool of claim **24**, further comprising updating means for updating the information stored.

27. The tool of claim **21**, further comprising displaying means for displaying at least one of vehicle information and tire pressure monitor system information.

28. The tool of claim **27**, wherein the tire pressure monitor system information comprises at least one of tire pressure, tire pressure sensor identification, and sensor mode.

29. The tool of claim **21**, further comprising resetting means for resetting the tire pressure monitor system.

30. The tool of claim **29**, further comprising notifying means for notifying a user that a tire pressure monitor system has been reset.

31. The tool of claim **30**, wherein the notifying means is configured to notify the user by causing at least one of a vehicle horn to sound and at least one vehicle light to flash.

32. The tool of claim **29**, further comprising manual referencing means for referencing a vehicle user manual.

33. The tool of claim **32**, further comprising update interfacing means for interfacing with the storing module.

34. The tool of claim **33**, wherein the update interfacing means comprises an RS232 port.

35. The tool of claim **21**, further comprising diagnosing means for diagnosing the at least one tire pressure sensor.

36. The tool of claim **21**, wherein the tire pressure monitor system determining means requests vehicle data.

37. The tool of claim **36**, wherein the vehicle data comprises vehicle make, model, and year data.

38. The tool of claim **21**, wherein the tire pressure sensor initiating means comprises feedback means for providing feedback regarding at least one of a signal received by the tool and successful initiation.

39. The tool of claim **21**, further comprising transmitting means for transmitting a signal from the tool to the tire pressure monitor system.

40. The tool of claim 21, further comprising receiving means for receiving a signal from at least one of the tire pressure monitor system and the at least one tire pressure sensor.

41. A method of using a tire pressure monitor system comprising:

interfacing a tire pressure monitor tool with a vehicle electronic control unit;

determining a type of tire pressure monitor system installed on a vehicle; and

initiating at least one tire pressure sensor.

42. The method of claim 41, further comprising determining an initiation procedure associated with the tire pressure monitor system.

43. The method of claim 41, further comprising selecting an initiation procedure associated with the tire pressure monitor system.

44. The method of claim 41, farther comprising storing information regarding at least one of a maintenance history and at least one tire pressure monitor system.

45. The method of claim 44, further comprising accessing the information stored.

46. The method of claim 44, further comprising updating the information stored.

47. The method of claim 41, further comprising displaying at least one of vehicle information and tire pressure monitor system information.

48. The method of claim 47, wherein the tire pressure monitor system information comprises at least one of tire pressure, tire pressure sensor identification, and sensor mode.

49. The method of claim 41, further comprising resetting the tire pressure monitor system.

50. The method of claim 49, further comprising notifying a user that a tire pressure monitor system has been reset.

51. The method of claim 50, wherein the notifying causes at least one of a vehicle horn to sound and at least one vehicle light to flash.

52. The method of claim 49, further comprising referencing a vehicle user manual.

53. The method of claim 41, wherein the interfacing uses an RS232 port.

54. The method of claim 41, further comprising diagnosing the at least one tire pressure sensor.

55. The method of claim 41, wherein the tire pressure monitor determining comprises requesting vehicle data.

56. The method of claim 55, wherein the vehicle data comprises vehicle make, model, and year data.

57. The method of claim 41, wherein the initiating comprises providing feedback regarding at least one of a signal received by the tool and successful initiation.

58. The method of claim 41, further comprising transmitting a signal from the tool to the tire pressure monitor system.

59. The method of claim 41, further comprising receiving a signal from at least one of the tire pressure monitor system and the at least one tire pressure sensor.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

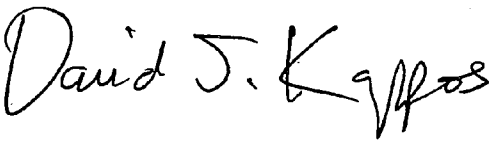
PATENT NO. : 7,623,025 B2
APPLICATION NO. : 11/589091
DATED : November 24, 2009
INVENTOR(S) : Garret Miller and Robert Kochie

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 11, line 43: please replace "fire" with --tire--;
Column 11, line 46: please replace "fire" with --tire--;
Column 11, line 64: please replace "fire" with --tire--;
Column 13, line 18: please replace "farther" with --further--.

Signed and Sealed this

Thirteenth Day of April, 2010



David J. Kappos
Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

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It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page, Item (75) Inventors, please add --Robert Kochie, Kasson, MN (US)--;
Column 11, line 43: please replace "fire" with --tire--;
Column 11, line 46: please replace "fire" with --tire--;
Column 11, line 64: please replace "fire" with --tire--;
Column 13, line 18: please replace "farther" with --further--.

This certificate supersedes the Certificate of Correction issued April 13, 2010.

Signed and Sealed this

Eleventh Day of May, 2010

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office